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## GEOLOGY, No. 2.—ON THE ORDER OF SUCCESSION OF THE ROCKS COMPOSING THE CRUST OF THE EARTH.

THE existence of an expansive subterranean power, generated by heat, is so well established by volcanic phenomena, as to render it unnecessary at present to support that opinion, by entering upon any discussions respecting what has been called *central heat*, founded upon the temperature of the earth, the ocean, or that of the thermal springs found in different parts of the world. With a view to apply that kind of knowledge appropriately, we shall hereafter recur to these branches of our subject.

We have given on the next page a tabular view of the known rocks of the crust of the earth, comprehending the general geological series of beds, of which that crust is composed; and lying in that relative order to each other in the series, according to which they are here enumerated. That is to say, that No. 18 is never found underlying No. 17, or No. 9 overlying No. 34. We take these examples at random, and mean merely to assert, that the order has not yet, in any part of the world, been found inverted; and therefore we reasonably conclude, that each of the beds of the series has successively come into the place it is constantly found to occupy. If we could assert with equal certainty, that all these beds were to be found thus overlying each other in every part of the world, then we might generalize still further, and say, that this observed order of the beds, was an effect of causes general to all the parts of the world; but the present state of geological knowledge does not authorize us to assert universal formations.

Although we know that all these beds of the general geologi-

## A TABULAR VIEW

### *Of the known Rocks of the Crust of the Earth.*

| | | | No. | | Feet. |
|---|---|---|---|---|---|
| TERTIARY | | SUPERIOR ORDER. | 41 | Alluvium | |
| | | | 40 | Diluvium | |
| | | | 39 | Upper fresh Water | 60 |
| | | | 38 | Upper Marine | 160 |
| | | | 37 | Lower fresh Water, Gypseous | 170 |
| | | | 36 | London Clay | 110 |
| | | | 35 | Plastic Clay | very variable |
| SECONDARY. | | SUPERMEDIAL ORDER. | 34 | Chalk with Flints<br>Chalk without Flints } . . . | 700 |
| | | | 33 | Upper Green Sand | 100 |
| | | | 32 | Gualt | 150 |
| | | | 31 | Lower Green Sand | 250 |
| | | | 30 | Weald Clay | 300 |
| | | | 29 | Hastings Sand | 400 |
| | | | 28 | Purbeck Limestone | 250 |
| | | | 27 | Portland Oolite | 120 |
| | | | 26 | Kimmeridge Clay | 500 |
| | | | 25 | Coral Rag | 150 |
| | | | 24 | Oxford Clay | 600 |
| | | | 23 | Cornbrash | 30 |
| | | | 22 | Forest Marble | 50 |
| | | | 21 | Bradford Clay | 50 |
| | | | 20 | Great Oolite | 130 |
| | | | 19 | Fuller's Earth | 140 |
| | | | 18 | Inferior Oolite | 180 |
| | | | 17 | Lias | 500 |
| | | | 16 | Variegated or red Marle | 500 |
| | | | 15 | Muschelkalk | 300 |
| | | | 14 | New red Sandstone | 300 |
| | | | 13 | Zechstein | 500 |
| | | | 12 | Exeter red Conglomerate | 500 |
| | | MEDIAL ORDER. | 11 | Coal Beds | 1000 |
| | | | 10 | Millstone Grit and Shale | 700 |
| | | | 9 | Carboniferous Limestone | 850 |
| | | | 8 | Old red Sandstone | 1500 |
| | TRANSITION. | SUBMEDIAL ORDER. | 7 | Greywacke | |
| | | | 6 | Transition Limestone | |
| | | | 5 | Alum Slate<br>Whetstone Slate<br>Flinty Slate | |
| PRIMARY. | | | 4 | Serpentine<br>Greenstone Slate<br>Talcose Slate<br>Hornblende Rocks<br>Primary Limestone | |
| | | INFERIOR ORDER. | 3 | Mica Slate | |
| | | | 2 | Gneiss | |
| | | | 1 | Granite | |

cal series have been found in their respective positions, wherever they have been observed, still in no part of the world have all the beds been found, in any one particular place, thus overlying each other. In every part of the world some of them are wanting. In Europe, that groupe of beds called the oolitic series, or *calcaire du Jura* according to the French, and which includes Nos. 17 and 27, (Lias and Portland oolite)—with the intermediate beds,—of our Tabular View, is very common, but has not yet been observed in North America: this groupe has an average thickness of 2700 feet, in England. The groupe including Nos. 12 and 16, usually called the new red sand stone formation, is common in Germany; but in this last country it includes a member for which no equivalent has yet been found in England, viz. the Muschelkalk, which has an average thickness of 300 feet. The defective distribution of particular beds in various parts of the world, affords, however, no argument against the successive order in which all the beds have come to their places in the series; for wherever they are found, they are constant in their relative succession to each other. The occasional absence then of particular beds, is to be attributed to causes which are the legitimate objects of geological research. Without practical investigations, we are not authorized to say, that the absence of any bed is a casus omissus, occasioned by the local deficiency of the causes which have produced the bed in other places; because the bed may have been deposited, and have subsequently disappeared, through the agency of causes which have frequently changed the condition of the surface of the earth, by wasting extensive portions of it.

The chalk, which in some parts of Europe has an average thickness of 700 feet, is remarkable, above all other beds, for containing, in the upper part of its white mass, irregular beds of nodules of dark coloured flint. We remember standing on the summit of Haldon Hill in Devonshire, England, half way between the city of Exeter and the coast, whence one of the most magnificent views in Europe is to be enjoyed, and replete with geological interest. At the foot of the hill lies a rich and broad valley, with the river Ex flowing through it: to the right lies the ocean. At a great distance in front, the chalk cliffs in Dorsetshire are perceived. Haldon Hill is composed of green sand, No. 33, and is there lying on the red marle, No. 16; all the other

beds to No. 30, inclusive, being deficient: it will be remembered that the bed which covers the green sand in the series, is the chalk No. 34. But the chalk is not there; and an unobserving traveller would cross this lofty barrier without being reminded of the chalk. A geologist, however, is at once struck with the immense heaps of flints deposited in various parts of this hill, some in entire nodules, exactly as they are found in the chalk, and others broken up and comminuted into a thousand pieces. His eyes are soon opened to the truth, and he sees that the chalk has once been here, and that some cause has put an immeasurable water power into operation, which has scooped out the vale of Ex, washed out all the cretaceous matter for many miles, in which the flints were embedded, and left them behind as monuments of their former position and its irresistible force. We consider this as one of the remarkable proofs of diluvial action. Neither is this the only part of Europe where chalk flints are found similarly distributed. They occur in other parts of England, and in Scotland, where no chalk has been yet observed. In Lower Saxony, chalk flints are very extensively distributed; the destruction of the chalk beds there has not been so entire as in other places, for Dr. Buckland observed a chalk pit near Luneberg.

The deficiency of beds is not peculiar to Europe, being common to North America. We have seen that the oolitic series so common in the former country is wanting here; yet this circumstance by no means affords ground for an argument, that the general geological system of North America has been established by causes of a different character: if it proves any thing, it proves that the causes to which the absence of particular beds is to be ascribed, have been common to both countries, and hence we may the rather infer that general agreement of geological causes which observation has already established. We propose hereafter to make it appear that a great portion of the beds belonging to the geological series of Europe, is regularly represented in this country, and that the beds, including the granite and the coal beds, Nos. 1 and 11, occur on this continent in the regular order. Taking the estimated thickness of the crust of the earth at 40,000 feet, comprehending all that man has seen in the deepest mines, up to the tops of the loftiest mountains, and deducting from it the aggregate thickness of the beds lying above

the coal, No. 11, in the general series, which is about 7,500 feet, we can assert that the geological agreement in relation to mineral structure and succession of rocks between America and Europe, is as 32,500 to 40,000. We shall hereafter show other mineral analogies which raise the scale of agreement of this country with transatlantic geology, and without drawing upon the branches of organic nature.

In relation to the absence of particular beds of the general series, on this continent, we have many curious instances. We have personally examined a geological line, extending from Boston, in Massachusetts, to Washington, in the District of Columbia—and which we know extends much farther, both north and south,—where the extremes of the geological series meet. At Boston, New York, Philadelphia, Baltimore, and Washington, there are no beds between the primary rocks and the superficial soil, No. 40, usually called diluvium. Of the particular causes which have produced this extreme continuous deficiency, we shall not treat here, and shall only observe, that no deduction can be drawn from this circumstance to support an opinion, that any set of causes has been in operation on this continent, in the construction of the primary, other than those which have produced the primary beds in Europe; because at one of the points of the geological line we have spoken of—New York—whilst the compact part of the city is built either upon the diluvium which rests upon the gneiss, No. 2, or upon the gneiss itself; at a very short distance from the city, we find the serpentine, No. 4, branching from Hoboken, in New Jersey, under the Hudson river, and superincumbent upon the gneiss; and a few miles further to the north, the primitive limestone in its proper place, lying upon the mica slate, No. 3. And as in many other instances we find each of the beds of the general series of unequal thickness; sometimes in thick stratified masses, which taper off to a point and then disappear, to re-appear again at unequal distances; so we are not to conclude that deficiencies of this various character are the effect of the absence of causes here, which have operated in other parts; or that the difference between the state of the geological series of rocks in this and in transatlantic countries, is to be attributed to the action of antagonist causes; but rather hold to the opinion, that these deficiencies are in fact interruptions of continuity, occasioned by the irregular action of the

causes which have deposited all beds. We have said thus much in relation to deficiencies of beds in the general geological series, knowing how necessary it is for students to have proper views of this branch of the subject; and we take leave of it for the present, with the remark, that our uninitiated readers are to remember that the tabular view we present them with, does not represent any actual section in nature: that we know of no part of the world where all the beds are laid upon each other horizontally in the order here enumerated; but that some of the beds are found in some countries, and others in other countries, and that in England they have all been found with the exception of the Muschelkalk before mentioned, No. 15; and that wherever each and every bed has been found, it has always been found, as to its place in the series, in the same relative position, never above its superior number, never below its inferior; from whence we satisfactorily infer, that each of the beds has come in succession into its place; and that if they were all collected and laid upon each other in one column, the tabular view we have annexed to this article, would be a true representative of it.

We have now to speak of another class of rocks, which we have excluded altogether from the tabular view, on account of the very irregular manner in which they are found in various parts of the geological series. These have received the generic name of trap, a term derived from the Swedish word *trappa*, a stair, from rocks of this kind being sometimes found in prismatic forms, rising in stages above each other, and resembling steps or stairs. We refer our readers to our last number, where, at page 311, they will find some information about these rocks. Their constituent minerals are generally the same as those which constitute modern lavas. The igneous origin of these trap rocks is now universally admitted. Such is the intensity of heat of modern lavas, that they are capable of melting down the older rocks; and indeed the lava of Skapta Jokul, in Iceland, to which we have referred at page 294, did this to a great extent in 1783, spreading itself out into broad lakes of fire, sometimes from twelve to fifteen miles wide, and one hundred feet deep. Eleven years after this period, smoke was still rising from parts of the lava, and hot water was found in several of the fissures. Rocks of this intrusive kind, and of the same mineralogical character, are found in various parts of the geological series, sometimes overlaying in

prismatic forms extensive areas; at other times existing in amorphous masses which put out numerous branches into the adjacent rocks, ejected from those masses, as it were, with intense heat and velocity. There is a singular mineral vein of this kind in England, which we have personally traced more than fifty miles, passing easterly from the county of Durham, to the sea in Yorkshire, between Whitby and Scarborough. This *Dyke*, as it is there called, cuts, in its upward course, through the carboniferous limestone, No. 9, the coal beds, and many other superincumbent beds into the oolitic series. It appears to be broader the nearer it approaches to the primary rocks. Mr. Bakewell observed it 30 feet broad at Sillow Cross, and twice that width further west. When we reflect that all modern lavas are poured out from volcanos, which are but the vents of a fierce igneous action striving in profound depths, and that lavas in various parts of the world have been observed to have flowed out to the surface, through the granite, the lowest of all rocks; we can but concur in the now universally received opinion, that these trap or intrusive rocks have an igneous origin, and that they all, at various periods, have been projected from those cavities which are inferior to all the known rocks, and which are unsearchable to man. These ancient eruptions having, like the modern ones, taken place at separate periods, we of course find the evidences of them irregularly distributed through the geological series. It is for this reason we have excluded them from a system of beds remarkable for its regularity in all parts of the world, where its members have been recognized; a systematic regularity, the importance of which no one can be insensible to, who is not disposed to attribute invariable succession to mere chance. The geological phenomena consequent upon the origin and action of these intrusive rocks, forming one of the most conspicuous branches of geology, we shall hereafter have frequent occasion to return to them.

We now feel bound to offer some explanation to our readers, of the nomenclature contained in the tabular view. When we come, in another number, to treat successively of the different beds, we shall offer explanations of the names by which we have at present designated them, being those by which they are known in the various geological treatises in the English tongue. That this nomenclature may be hereafter greatly modi-

fied, or entirely merged, together with the modern classification of rocks, in the improved views which may belong to a further progress in the science, is not improbable: we are of opinion, however, that the present state of geological knowledge does not warrant any material interference with the arrangements accompanying the tabular view. No part of the world presents such a complete assemblage of the rocks of the geological series as England, and in an especial manner of the secondary rocks. It is this circumstance which has caused geological knowledge to be pre-eminently cultivated by the English. Mr. William Smith, the father of English geology, was the first to assign a proper importance to the rocks of the oolitic series: many of them received local names connected with the places where he identified them; the term *cornbrash* has been censured as a barbarism; but it was eminently characteristic—as upon a future occasion we shall show—of the rock to which Mr. Smith, in the first instance, applied this designation. Many of these English names thus given by Mr. Smith, have been changed by French geologists. *Kimmeridge clay*, so called from a small place on the English coast where this bed is found, has already received in France the respective names of *marne argileuse havrienne*, and *argile de honfleur*. *Oxford clay* is called *argile de dives*. This perhaps is inseparable from the building up of the science; observations made simultaneously in different countries, will be noted in the respective language of the countries where they are made, and the final simplification of what is really injurious to science, is often retarded by a degree of national feeling it is painful to sacrifice. At some future day, no doubt a more simple character will be applied to classification and nomenclature in geology, and what Lavoisier did for chemistry will be done for this science. We shall receive it with gratitude, whether it comes from the country of Cuvier, Al. Brogniart and Elie de Beaumont, the acknowledged ornaments of the French school of geology, or from any of their celebrated colaborators across the channel; but since we cannot adopt the synonymes of all nations into a tabular view of the geological series—and we foresee that the war of classification and synonymes will be waged among geologists before a treaty of peace is signed amongst the Zoologists—we recommend to our readers to adhere to the established names we present them with, because they are recognised in the treatises most ac-

cessible to them, and because we believe there are already more geological readers in our overspreading language than in any other, and that the proportion will greatly increase.

To our uninitiated readers, we think it due to offer a short history of one of those subdivisions of the geological series, which we have connected with our tabular view. Primary, transition, secondary, and tertiary. For an account of the first, we refer them to our last number, page 293, which contains our reasons for substituting the term primary, for primitive. The rocks, 1 to 4 inclusive, are those comprehended in the primary division; they have hitherto been found entirely composed of inorganic matter; whether because organized vegetable and animal beings had not been produced, when these rocks were first consolidated; or whether because the igneous origin of the greater part of these rocks was inconsistent with the preservation of organic forms.

In the early periods of the history of Geology, all rocks were divided into primitive and secondary; the evidences of organic nature being entirely confined to this last and most numerous branch. This last division being evidently too cumbrous, could not escape further subdivision; and it being observed that the lowest rocks in the secondary portion contained the first and the simplest forms of organized bodies, the lowest portion of the secondary got the name of transition, as if at the period of the consolidation of these rocks, the planet was in a state of transition from inorganic to organic matter. The exact line where the transition begins, and where it ends, has not yet been agreed upon universally. Those slates which are subordinate to the transition limestone, are considered, by geologists, as containing the first organic remains, none having yet been found in the serpentine, the talcose rocks and slates; or the hornblende rocks and calcareous deposits, which are superincumbent in the series to the primary. The English geologists have limited the extent of the transition to the graywacke, No. 7, inclusive; whilst the continental geologists would include in it the old red sand stone, the carboniferous limestone, and some of them even the coal beds. As this difference in opinion may, perhaps, at no very distant day, be reconciled by the oblivion into which the transition itself may fall; and as it is a question of organic remains, somewhat of a speculative nature, from the imperfect examination those rocks have received, we shall content ourselves with the

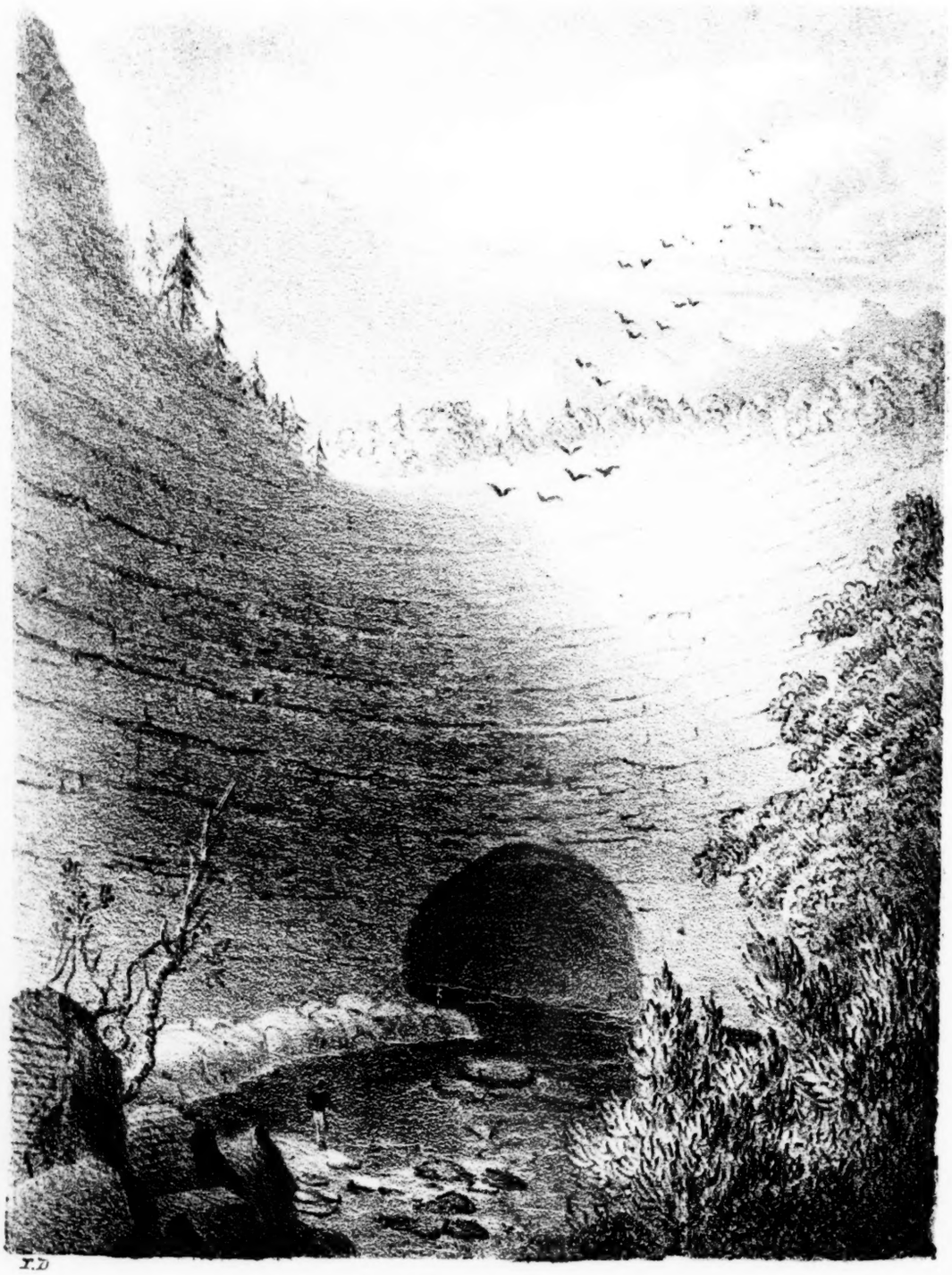
explanation we have given of the meaning of the term. The remaining part of the series, from the coal to the chalk inclusive, is universally called secondary.

The tertiary includes that portion of the series from the chalk to the present surface of the earth. It is replete with interest, whether we consider it as the terminating part of a long series of rocks, connecting the present with the ancient order of nature, or as being rich, in an exceeding manner, in marine, fresh water, and organic remains.

The other subdivision of the geological series into five orders, superior, supermedial, medial, submedial and inferior, is from the Rev. Mr. Conybeare. It is disconnected with every kind of theory, and pretends to no merit beyond the very convenient manner in which it arranges the geological series into five subdivisions. There is not a more gifted geologist in Europe, than Mr. Conybeare; nor one more capable, in the present state of the science, of offering to the public a more philosophical arrangement, founded upon natural distinctions.

We have prefixed numbers to the beds, for more convenient reference, beginning with granite, the lowest of the primary rocks, and terminating with No. 41, the superficial alluvium, being the last bed in the series, and that which is constantly forming by the agency of floods, streams, and tides. The other column of numbers represents the average thickness of the respective beds in Europe, as it has been computed by the most reputed geologists.

It is proposed, in the course of these essays, to review each of these beds in detail; explaining their position, mineral structure, and the nature of the organic remains imbedded in them. An opportunity will then be presented of describing the beds in North America, and of comparing the geological phenomena belonging to them, with those of other countries. It is by such means alone, that an effectual progress in general geology can be made; for, to use the language of the Rev. Mr. Conybeare, "*we may be sure that any analogies which are common to localities, geographically so distant, and placed under physical conditions so distinct, are, in truth, analogies belonging generally to the whole globe; and thus we shall obtain a data adequate for the foundation of a general geological theory.*" The attention which has been hitherto paid to North American geology, has been, comparatively, so



NATURAL TUNNEL. SCOTT COUNTY VIRGINIA.

*From Childs & Inman's Press.*

slight, that it would be absurd to offer the series of North American beds, as we are now acquainted with them, as a general type for students: that course, therefore, will be followed, which promises the greatest general degree of instruction on the subject, and which may lead new observers into the field. When inaccurate statements concerning North American geology are brought forward—and to which we are unavoidably exposed—we shall be gratified if some of our correspondents will furnish us with correct information, relying upon our sense of justice to give them proper credit for it.

In regard to scientific terms and technicalities, where we are obliged to use them, we shall endeavour to accompany them with proper explanations: but as many terms used in geology require a somewhat more elaborate definition, than they hitherto appear to have received, it is our intention, from time to time, to insert such definitions in our Journal, and at appropriate periods.

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## DESCRIPTION OF A NATURAL TUNNEL, IN SCOTT COUNTY, VIRGINIA.

*By* Lieut. Col. Long, *U. S. Army.*

During the past summer, I visited a remarkable natural bridge in Scott county, Virginia, to which I have given the name of Natural tunnel, on account of its striking resemblance to artificial structures of that kind. An account of a phenomenon so rare, and hitherto unknown beyond its immediate neighbourhood, appeared to me to deserve a place in the Monthly American Journal of Geology. I esteem myself fortunate in being able to contribute so interesting a novelty to its varied pages.

The immediate locality of this tunnel is upon a small stream called Buck-eye, or Stock creek. This last name owes its origin to its valley having been resorted to by the herdsmen of the country, for the attainment of a *good range*, or choice pasture ground for their cattle. The creek rises in Powell's mountain, and is tributary to Clinch river, which it enters at the distance of between two and three miles below the tunnel. The aspect of the surrounding country, and especially of that to the northward of the tunnel, and constituting the southerly slope of the mountain just mentioned, is exceedingly diversified and broken,

by elevated spurs and ridges, separated from each other by deep chasms, walled with cliffs and mural precipices, often presenting exceedingly narrow passes, but occasionally widening into meadows or bottoms of considerable extent. The mural precipices just mentioned, occur very frequently, bounding the valleys of the streams generally in this part of the country, and opposing ramparts of formidable height, and in many places utterly insurmountable. Such are the features peculiarly characteristic of *Wild Cat Valley*, the *Valley of Copper Creek*, of Powell's and Clinch rivers, and of numerous other streams of less note, all of which are situated within a few miles of the natural tunnel.

To form an adequate idea of this remarkable and truly sublime object, we have only to imagine the creek to which it gives a passage, meandering through a deep narrow valley, here and there bounded on both sides by walls or *revetements* of the character above intimated, and rising to the height of two or three hundred feet above the stream; and that a portion of one of these chasms, instead of presenting an open *thorough cut* from the summit to the base of the high grounds, is intercepted by a continuous unbroken ridge more than three hundred feet high, extending entirely across the valley, and perforated transversely at its base, after the manner of an artificial tunnel, and thus affording a spacious subterranean channel for the passage of the stream.

The entrance to the natural tunnel on the upper side of the ridge, is imposing and picturesque, in a high degree; but on the lower side, the grandeur of the scene is greatly heightened by the superior magnitude of the cliffs, which exceed in loftiness, and which rise perpendicularly—and in some instances in an impending manner—two to three hundred feet; and by which the entrance on this side is almost environed, as it were, by an amphitheatre of rude and frightful precipices.

The observer, standing on the brink of the stream, at the distance of about one hundred yards below the debouchure of the natural tunnel, has, in front, a view of its arched entrance, rising seventy or eighty feet above the water, and surmounted by horizontal stratifications of yellowish, white and grey rocks, in depth nearly twice the height of the arch. On his left, a view of the same mural precipice, deflected from the springing of the arch in

a manner to pass thence in a continuous curve quite to his rear, and towering in a very impressive manner, above his head. On his right, a sapling growth of buck-eye, poplar, linden, &c., skirting the margin of the creek, and extending obliquely to the right, and upward through a narrow, abrupt ravine, to the summit of the ridge, which is here, and elsewhere, crowned with a timber growth of pines, cedars, oaks, and shrubbery of various kinds. On his extreme right, is a gigantic cliff lifting itself up perpendicularly from the water's edge, to the height of about three hundred feet, and accompanied by an insulated cliff, called the chimney, of about the same altitude, rising in the form of a turret, at least sixty feet above its basement, which is a portion of the imposing cliff just before mentioned.

Desirous of illustrating this paper by a front view of the natural tunnel where the creek issues from it, I have, with the assistance of a particular friend in this city—to whom I am indebted for the accompanying drawing*—been enabled to furnish a sketch which very faithfully represents some of the appearances I have described. The embellishments last mentioned, however, viz. the chimney and its accompaniments, could not be comprised in the landscape.

In order to give a more full description of the magnificent spectacle which forms the subject of this paper, I shall transcribe some of the minutes taken from my private notes, whilst on the ground; but first I shall give an extract from a letter addressed to me by my friend P. C. Johnston, Esq. of Abingdon, in the adjoining county to Scott, a gentleman well acquainted with this interesting locality.

"The rocks through which Stock creek flows, are a light blue and gray limestone, of a subcrystalline character; the strata are nearly horizontal; and this arrangement of the strata is obvious for several miles north-eastwardly; but in every other direction, very near the bridge, (natural tunnel,) they have the dip usual in the country to the S. E. at an angle generally of from 30° to 50°. This tunnel is near what I have believed to be the N. W. boundary of the transition formation, a little within it. I have not been able to discover any organic remains in the limestone there, or in the neighbourhood. On the little projections of the rock which occur on the walls, near the lower (S.) end of the

* See Plate X

tunnel, a crystallized deposit is lodged, which you no doubt recollect, that seemed to my taste to be a mixture of salt-petre and alum. No attempt has been made to analyze it. The earth found near the upper (N.) extremity of the tunnel some years ago, (the first time I visited it,) afforded salt-petre. The crystallized deposit seems to be made from a stratum apparently not more than six inches thick, which is so high that it cannot be reached for examination. The growth of timber is such as is common in the neighbouring country, white, red, spanish, black-oaks; hickory, white-walnut, dogwood, poplar, chesnut, birch, ironwood; some hemlock and papaw (asimina triloba) on the banks of the creek, and the edges of the cliffs fringed with cedar. On the creek, below the tunnel for two miles, is found that variety of ash called the fringe tree, (chionanthus virginica,) the long white fringe-like blossoms of which are so delightfully fragrant."*

The following passages are from my own private journal.

"Saturday, Aug. 13, 1831. Having ascended Cove ridge, we turned aside from our route to visit the natural bridge, or tunnel, situated on Buck-eye, or Stock creek, about a mile below the Sycamore camp,† and about one and a half miles from a place called Rye cove, which occupies a spacious recess between two prominent spurs of Powell's mountain, the site of the natural tunnel being included within a spur of Cove ridge, which is one of the mountain spurs just alluded to. Here is presented one of the most remarkable and attractive curiosities of its kind to be witnessed in this or any other country. The creek, which is about seven yards wide, and has a general course about S. 15 W. here passes through a hill elevated from two to three hundred feet above the surface of the stream, winding its way through a huge subterraneous cavern, or grotto, whose roof is vaulted in a peculiar manner, and rises from thirty to seventy or eighty feet above its floor. The sides of this gigantic cavern rise perpendicularly in some places to the height of fifteen or twenty feet, and in others, are formed by the springing of its vaulted roof immediately from

* This plant, in the natural system, belongs to the *oleaceæ*, or olive tribe. The flowers of the olea fragrans are used for flavouring tea in China. We offer this hint to our readers who have access to the chionanthus. Ed.

† This designation has been given to a spot in the valley of the creek, where formerly stood a hollow sycamore (platanus occidentalis) tree of an enormous size, the remains of which are still to be seen, and in the cavity of which, whilst it stood, fifteen persons are said to have encamped at the same time together.

its floor. The width of the tunnel varies from fifty to one hundred and fifty feet; its course is that of a continuous curve, resembling the letter S, first winding to the right as we enter on the upper side, then to the left, again to the right, and then again to the left, on arriving at the entrance on the lower side. Such is its peculiar form, that an observer, standing at a point about midway of its subterranean course, is completely excluded from a view of either entrance, and is left to grope in the dark through a distance of about twenty yards, occupying an intermediate portion of the tunnel. When the sun is near the meridian, and his rays fall upon both entrances, the light reflected from both extremities of the tunnel, contributes to mollify the darkness of this interior portion into a dusky twilight.

"The extent of the tunnel from its upper to its lower extremity, following its meanders, is about 150 yards, in which distance the stream falls about ten feet, emitting, in its passage over a rocky bed, an agreeable murmur, which is rendered more grateful by its reverberations upon the roof and sides of the grotto. The discharge of a musket produces a crash-like report, succeeded by a roar in the tunnel, which has a deafening effect upon the ear.

"The hill through which this singular perforation leads, descends in a direction from east to west, across the line of the creek, and affords a very convenient passage for a road which traverses it at this place, having a descent in the direction just mentioned, of about four degrees."

The rocks found in this part of the country are principally sandstone and limestone, in stratifications nearly horizontal, with occasional beds of clay slate. A mixture of the two former frequently occurs among the alternations presented by these rocks. A variety of rock resembling the French burr, occurs in abundance on Butcher's fork, of Powell's river, about twenty miles northwardly of the natural tunnel. Fossils are more or less abundant in these and other rocks. Fossil bones of an interesting character have been found in several places. Salt-petre caves are numerous. Coves, sinks, and subterranean caverns are strikingly characteristic, not only of the country circumjacent to the natural tunnel, but of the region generally situated between the Cumberland mountain and the Blue ridge or Apalachian mountain. Bituminous coal, with its usual accompaniments, abounds in the northerly parts of this region; and in the intermediate and

southerly portions; iron, variously combined, often magnetic, together with talcose rocks, &c. &c. are to be met with in great abundance.

The mountains in this vicinity, long. 82° to 84° W. from Greenwich, lat. 35° to 36° N. are among the most lofty of the Allegheny range. Several knobs* in this part of the range, among which may be enumerated the Roan, the Unaka, the Bald, the Black, and Powell's mountains, rise to the height of at least four thousand five hundred feet above tide.

REMARKS BY THE EDITOR.

Our acknowledgments are due to that distinguished traveller Col. Long, for having enriched our Journal with a notice of a remarkable phenomenon of this continent, which no man has explored more extensively than himself. The natural tunnel which that gentleman has so well described, is a very rare spectacle, and considering its extent, unique of its kind. It belongs no doubt to that class of natural aqueducts which owe their origin to natural cavities in the rocks, and which are generally subterranean. Col. Long observes that coves, sinks, and subterranean caverns are strikingly characteristic of the whole region adjacent to the natural tunnel. This is the common character of that great limestone formation (carboniferous) which extends over so vast an area in North America, and which abounds in extensive subterranean caverns, whether in Kentucky, Virginia, or the Helderberg hills in New York. These caverns in the two former states, are of a surprising extent, and have been penetrated several miles. Many coves, and curiously complicated dells and vales in the south-western parts of the Apalachian ridges, probably owe their origin to the disintegration of the rocks, and the consequent destruction of the natural caverns. That this natural tunnel has not been worn through the rock by the long continued action of running water, is evident, not from the cavernous structure alone of the general country, but from the form of Powell's mountain, in a spur of which, this natural tunnel passes transversely. Powell's mountain is one of those innumerable knobs, out-liers, or independent hills, divided from the adjacent mountains by dells or vales, which are so numerous in that vast assemblage of Apalachian mountain ridges, which

* Out-liers of any particular ridge.

extends N. E. and S. W. 1200 miles, and has a mean breadth of about 100 miles between the Ohio river and the Blue ridge, in Virginia. In those dells, or vales, the head waters of those rivers which effect the drainage of the country east and west, have their rise. In the south-western corner of Virginia, where the eastern part of Tennessee, and the western part of North Carolina meet, there are slopes which send down the great Kenhawa to the north-west, the Tennessee to the south-west, and the Roanoke to the south-east. The Blue ridge has its north-eastern termination in York county, Pennsylvania, and from thence stretches south-west in an almost unbroken line to Burke county, N. Carolina, a distance of more than 350 miles, where it becomes the main ridge,* dividing between the waters of the Atlantic ocean and the Ohio river. West of this primary ridge lie the other ridges belonging to the transition and secondary The sources of the Roanoke lie at an elevation of about 1500 feet above tide water, on the western side of the Blue ridge, and contiguous to the sources of the great Kenhawa, which traverses the remaining part of the distance to the Ohio river, descending the vales, passing through the gaps of the ridges, and the dells and vales which separate the independent hills.

Stock creek is one of those sources of the Tennessee, and rises in a dell at the foot of Powell's mountain. On its way to Clinch river, to which it is tributary, and which itself is tributary to the Tennessee, it encounters a spur of Powell's mountain, which under the name of Cove ridge, terminates, as Col. Long has remarked, with a slope of about four degrees, affording a very convenient passage for a road. The stream passes through the tunnel not far from the termination of the spur, so that if originally

* It should, moreover, be remarked, in reference to the main ridge dividing between the Atlantic and Ohio waters, which may be regarded as the back bone of the Allegheny or Apalachian mountains, although distinguished by different names in different parts of its range, is nevertheless completely unbroken by ravines or water courses, throughout its whole extent, from its south-west extremity near the sources of the Tombeckbee river, in lat. 34 1-2 N. and long. 88° W. to the point where it is intersected by the west branch of the Susquehanna, in lat. 41 1-2 N. and long. 77 1-2 W. Beyond this point, north-eastwardly, the ridge or back bone ceases to maintain its characteristic continuity; but spreads in that direction into numerous ramifications, dispersed over a large extent of country, and presenting themselves in the form of detached knobs, or out-liers. The crest of this ridge has no where an elevation less than 2000 feet above tide; its course is very serpentine, and its entire length between the points above designated, is about 600 miles.

there had been no natural cavity in the rock, it is evident that the stream would have been deflected from its line; would have followed the base of the hill, and have turned the extreme point. We, therefore, without hesitation, refer the origin of this aqueduct to an original cavity in the mountain, and highly approve of the name of natural tunnel, which col. Long most appropriately has given to it.

We have been led into these remarks chiefly from a desire to draw the public attention to some conspicuous desiderata in the geology of this country. No geological surveys having yet been undertaken, our knowledge of the Apalachian mountains is very limited. The ridges, independent hills, and vales, are very numerous and diversified, and have not yet been geologically disentangled from each other. We are consequently unable to say, with confidence, where the mineralogical structure of the gold region has its precise limits, or where the primary rocks terminate, and the secondary begin. In truth, geologically speaking, very little is known of the details of the Apalachian ridges, even as it respects the place to which their rocks belong in the geological series. Of some portions of them, it is true, we have some information; but among these we cannot include the south-western portion in the country of this natural tunnel.

There is another very interesting branch, and as connected with the Apalachian ridges, of great importance. Many have considered them under their common designation of Allegheny mountains, as the dividing line of the western and eastern rivers. This is by no means so. The Susquehanna rises to the north beyond their area, and traverses obliquely their Pennsylvania terminations, on its way to the coast. The Potomac pursues for a while a north-east course, then turns to the east and penetrates through the greater mass of those ridges, before it takes its regular south-east course; and although the Rappahannock and Roanoke may be said to descend from the eastern slope of the Apalachians, yet the James river rises in their central parts, and the great Kenhawa, which flows north-westward into the Ohio, has its sources interlocking with those of the Roanoke. We want not only the details from which to deduce the causes which have governed the courses of these rivers, but proper data to reason upon, for the cause of those interruptions of continuity in the Apalachians, which have left so many knobs and hills, independ-

ent of the ridges, and for the origin of those gaps through which the streams now pass. We want to know whether by far the greater portion of them have been worn, not by the action of advancing streams, but by a retrocessive action, similar in nature to that which has removed the Falls of Niagara from Queenstown to their present station, of which we think to have given the proofs in our number for July, 1831, in an article on the ancient drainage of North America.

It will give us a lively sactisfaction to receive sensible and practical papers from our correspondents, on these interesting subjects.

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## VISIT TO BIG-BONE LICK, IN 1821.

*By* C. S. Rafinesque, *Professor of Historical and Natural Sciences, &c.*

Mr. Cooper, in his account of Big-bone Lick, has craved further information from other explorers. I shall, perhaps, add some additional facts to his. He has omitted Mr. John D. Clifford and myself among the explorers. To my knowledge Mr. Clifford visited the place in 1816 or 1817, and dug for bones. He procured many, which I have seen in his museum, in Lexington, among which a fine tusk of mastodon, and some horns of the oxen found there. His collection of bones has been removed, by purchase, to the museum of Cincinnati, and latterly to the Academy of Natural Sciences, of Philadelphia.

We proposed to visit this lick together in 1820; but his death that year prevented us. In 1821, I went with Dr. Short, from Lexington to Northbend, at the mouth of the great Miami. I left him there at his brother's seat on the Ohio, and went on purpose to the Lick by myself to explore it, and wait for him on his return. A horse having been lent to me, I went by the road of Cincinnati, following the banks of the Ohio. I visited in the way a beautiful elliptical mound, near the banks of the river, and the house of major Pratt. It has been preserved intact, with the trees that grow on it. The base measures 550 feet in circumference; it is 25 feet high, and the top is level 100 feet long from N. E. to S. W., by 50 feet broad. This mound, or altar, is nearly half way between the stone fort, at the mouth of the Miami, and the ancient city, temples, circus, and mounds on which Cincinnnati

has been built, now mostly levelled and destroyed. All are on the second bank of the Ohio.

Without stopping long in Cincinnati, I crossed there the Ohio to Covington, in Kentucky, on the west side of the mouth of Licking river. I went to survey the singular ancient monument near Covington, at Mr. Jacob Fowle's; the main road passes between two circular mounds of unequal size; the eastern is 12 feet high; the western 25, and has a pavilion on the top; but the singularity consists in a long sickle-shaped esplanade, running out of it to the south, which is 350 feet long, about 80 broad, and 8 feet high.

From Covington to Big-bone Lick, the distance is only 18 miles, nearly S. W. over the limestone upland, gently undulating: near the Lick the ground is more broken into ravines which open into the Big-bone valley.

I remained several days at the Lick, which is a watering place, with ample accommodations; but I found the actual owner a very surly man, who would no longer allow any excavations, having imbibed the notion that digging would take away the water from the spring, around which a pavilion and seats had lately been erected. Seeking for bones was then out of the question, and I spent my time in taking an ample survey of the place, the valley, and the landing on the Ohio, with the surrounding hills and monuments, now only two miles from the lick, where steam boats land their passengers. I made some maps and drawings, and collected several plants and fossils.

Mr. Cooper's account of the place is tolerably correct, but his map does not show all the streams, ravines and springs around the place, and omits entirely the remarkable ancient mound, connected with the Indian traditions mentioned long ago by Jefferson, in his notes on Virginia. Yet this mound is only 300 yards from the large boarding house, but in the woods on the steep hill behind it, towards the S. E. It is elliptical, 10 feet high, 430 feet in circuit at the base, 150 feet long, from N. to S. and is level on the top, with a hollow in the centre, which I ascribe to some late excavation, but am not positive, as no rubbish is seen.

This was the mound from which the Great Spirit destroyed the last mastodon, according to the tradition recorded by Jefferson.

Behind this mound, and towards the landing, are three small sepulchral mounds near one of the springs of the western branch

of Gunpowder creek, which empties itself into the Ohio at the landing; but the main branch comes from the north. The ridge separating the waters of Gunpowder and Big bone creeks, is not very high, and forms a kind of gap where the road crosses it: the lick may have once communicated with the Ohio by this gap.*

I walked to the landing, where there was a very inconvenient landing place; near it was a farm house only, the cliffs being there very near to the Ohio, quite steep, and subject to avalanches. I was told by the farmer, that not long ago, in a storm at night, he was frightened by a dreadful noise like an earthquake, which lasted a long while; and in the morning found a small ravine south of his house almost filled up by an avalanche of huge stones from the cliffs. I went to see the place, and found it so; the stones were of all sizes and shapes, but all angular; some must have weighed many thousand pounds, and yet had rolled 200 yards or more. These cliffs, as usual, are of limestone, in horizontal strata, and 200 feet at least above the river.

The water at the Lick springs contains salt and sulphur; it has a bluish cast, like that of the Blue licks, on Licking river; both are limpid, but of an abominable taste, although readily drank by the idlers who come there to loiter, drink, bathe, and kill the game—very plenty yet on the hills.

I should have wished to follow Big-bone creek to its mouth, but had not time. I have since regretted it, when I heard some years afterwards that a very singular ancient tomb had been found there. It was formed by two large slabs uniting into an angle above, and covered by the soil; some human bones were found in it, the fate of which I could not learn. I am inclined to believe it situated in the alluvion of the creek, which is ample in some places, and even contains many fossil shells, or unios, the same as those now inhabiting the creek and the Ohio. It would be interesting to know what connection may exist between this tomb, the mound on the hill, and the regular arrangement of the fossil bones at the lick, although I should myself be inclined to believe in the diluvial eddy which may have brought the bones there in a regular heap, in the bend of the valley.

At Blue licks, in a rocky valley, no bones and no monuments are found, but Drennon's lick has bones and mounds. Out of the

* Which is badly laid out in the map, as well as Gunpowder creek, erroneously called River creek.

limestone region, in the sandstone hills, many licks are found with fossils, but no bones and no monuments. Is it not strange that there should be an apparent connection between them, or rather their locality? as if some Indian tribe had collected these bones as relics.

The valley of Big-bone creek is nearly a mile wide at the lick and above it, but becomes much narrower below it, as if the lick had been formerly a basin, or small lake. All the hills are of horizontal blue limestone, with some shells, chiefly terebratulites, productus, &c. But the valley, with the sides of the hills, are of clay. This clay is of various hues and consistency, often mixed with sand and gravel, damp in the middle, dry and arid on the sides of the valley. It contains in the ravines several fossils, chiefly alcyonites and entrochites. The hills rise 120 to 180 feet above the valley. They are wooded and full of game, but with a very thin soil. The soil in the valley, near the lick, is rather sterile, but higher up becomes fruitful, and is well cultivated.

Many pretty plants are found in the valley and hills, but no saline plants. The stream of Big-bone often changes its course, and washes away its banks when it overflows in the spring. The back-water of the Ohio, when very high, comes near to the lick, and may have reached it formerly.

No bones were protruding or visible in the banks, in 1821; but some were visible as late as 1810, at least. The first European discoverer of this place was Longueuil, in 1739, who took away many bones to Louisiana and France. They were then quite out of the ground. He was led there by the Indians, who held the place as holy, and never took away the bones.

Having well explored the lick and valley, I returned to Lexington with Dr. Short, as soon as he called for me. This was in September, 1821.

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## NO. 1.—LETTER FROM AUDUBON TO THE EDITOR.

*St. Augustine, East Florida, Dec. 7, 1831.*

I AM now seated in earnest to give you an unceremonious summary of my proceedings up to this time, since we left Richmond, in Virginia. As a geologist, I venture to suppose you would have

been but indifferently amused, if you had been with us in our journey from this latter place to Charleston, in South Carolina; and as an ornithologist, I cannot boast of the enjoyment I found; poor coaches, dragged through immense deserted pine forests, miserable fare, and neither birds or quadrupeds to be seen. We at length approached Charleston, and the view of that city from across the bay, was hailed by our party with unfeigned delight. Charmed as we were with having terminated our dreary journey, it did not occur to us to anticipate the extraordinary hospitality which awaited us there, and which led to a residence of a few of the happiest weeks I ever passed.

I had passed but one night in the city, when I was presented to the Rev. Mr. ——. This benevolent man, whom I am proud to call my friend, would not suffer the 'American woodsman' to repose any where but under his roof; and not him alone—all his assistants too. When I tell you that he was an old friend of Alexander Wilson, that he shoots well, is an ornithologist, a philosophical naturalist, and that during the time we enjoyed his hospitality, he took us all over the country with his carriages and servants, in search of specimens, and that he was every thing that a kind brother could be to me, you may suppose that it is with great sincerity I say, and ever shall say, God bless him! When I first saw this excellent man, he was on horse-back; but upon my being named to him, it seems the love of ornithology rose within him, he leaped from his saddle, suffered his horse to stand at liberty, and gave me his hand with a pressure of cordiality that electrified me. I saw in his eyes that all he said was good and true; and although he spoke of my labours in terms far exceeding what is due to them, I listened to him, pretty well assured that he did not intend me to play the part of Gil Blas over again; for myself, my assistants George Lehman and Henry Ward, our arms, with our baggage, were removed in a jiffy to his own mansion, introduced to the family, and at work the very next morning. Whilst there, the weather, to be sure, was shockingly hot great part of the time; we nevertheless shot a vast quantity of birds, without meeting with any thing new. The picked specimens, after preparation, were despatched to our mutual friend H —, where great care will be taken of them until my return. I believe we prepared about 300 specimens, consisting of about sixty species of land and water birds. I jumped at once

into my wood-hunting habits. All hands of us up before day-break, and soon at work, either in the way of shooting, taking views, or drawing birds: after sunset—scribbling in our journals. At Mr. ——'s, our evenings were passed in a very agreeable manner. I received a great deal of information from him respecting the migration, residence, and nidification of many species, whose habits I was but partially informed of. In the early part of November, the alligators had gone into their winter quarters; the migratory birds were passing swiftly on towards the south, although we had had no frost. The planters considered the country as still unhealthy, and resorted to the city at night. If I had been governed by the practice and advice of many, I should not have put a foot in the mud, either salted or fresh; but difficulties of this character must be disregarded by the American woodsman, while success, or the hope of it, is before him.

It is impossible to do justice to the generous feelings of the Charlestonians, or to their extreme kindness towards me. Many of the gentlemen took the greatest interest in my pursuits; one, Dr. ——, presented me with an excellent New-Foundland dog, and other valuable memorials of his regard. Another, Dr. ——, gave me a collection of shells, from the adjacent waters. The ladies presented me with a capital supply of snuff. Desirous of going to Cole's Island, distant about 25 or 30 miles, to look after some marine birds, a boat, four hands, and a pilot, were immediately offered to me, free of all expense, with liberty to detain them as long as it was agreeable to me. It is not possible for me to express properly the sense I feel of the kindness I received from that warm-hearted and intelligent people.

And now, as you have good naturedly listened to what I have felt bound to say on the score of gratitude, I will tell you what I know you are impatient to come to—something about my proceedings at Cole's Island. It lies south from Charleston, about 25 or 30 miles; there we arrived and encamped for the night: certain beef-steaks we brought with us, we roasted upon sticks, and the adjacent shore provided us with excellent oysters: gaiety, good appetites, and our hearts all right, made the time pass pleasantly, and it was with some reluctance we spread our blankets, and arranged the fire preparatory to going to rest. Nothing is more valuable to a naturalist, and particularly to an ornithologist, than the first hours of day; therefore, long ere the

sun had glowed over the broad sea that lay before our camp, we had reached another island where birds resort to roost by thousands; but, notwithstanding these multitudes, not a new species did we procure. We, however, had the pleasure of observing two noble "birds of Washington," sailing majestically over the broad watery face.

But it was necessary to bring my stay in Charleston to a close, and it was somewhat difficult too. My friends had increased in number, they were in the habit of accompanying me in my shooting excursions, I was becoming very much attached to them, invitations poured in from various parts of the country; and I really believe, that had I been willing, we might have remained there and in the neighbourhood, if not all our lives, at least as long as would have caused a rare scarcity of the feathered tribes, in that portion of the Carolinas. But my mind was among the birds farther south; the Floridas, Red river, the Arkansas, that almost unknown country California, and the Pacific ocean. I felt myself drawn to the untried scenes of those countries, and it was necessary to tear myself away from the kindest friends.

We embarked in the schooner Argus, the wind was fair, and we hoisted all sails for the Floridas. Our passage was not short, the wind changed, and we put back into St. Simon's Island Bay. This was one of the few put backs in life of a fortunate kind for me. I made for the shore, met a gentleman on the beach, presented him my card, and was immediately invited to dinner. I visited his gardens, got into such agreeable conversation and quarters, that I was fain to think I had landed on some one of those fairy islands said to have existed in the golden age. But this was not all; the owner of this hospitable mansion pressed me to stay a month with him, and subscribed to my Birds of America, in the most gentlemanly manner. This was T. R. K., Esq. But the wind shifted, and I was sent for, and our voyage for St. Augustine resumed.

St. Augustine, whatever it may have been, is far from being a flourishing place now. It lies at the bottom of a bay, extremely difficult of access, even for vessels of light draft, which seldom reach the "city" in less than a day. I cannot say much for the market, nor for the circumjacent country. Oranges and plenty of good fish, seem to constitute the wealth of the place. Sands,

poor pine forests, and impenetrable thickets of cactus and palmettos, form the under growth. Birds are rare, and very shy; and with all our exertions, we have not collected one hundred skins in a fortnight that we have been here. I have received many kind attentions, and numerous invitations to visit plantations, on our way to the south, where I shall direct my steps in a few days. I have drawn seventeen species, among which one *mongrel vulture*, which I think will prove new. You will see it, I hope, very soon.

I will give you a sketch of our manner of passing the time. We are up before day, and our toilette is soon made. If the day is to be spent at drawing, Lehman and I take a walk, and Ward his gun, dog, and basket, returning when hungry, or fatigued, or both. We draw uninterruptedly till dusk, after which, another walk, then write up journals, and retire to rest early. When we have nothing on hand to draw, the guns are cleaned over night, a basket with bread and cheese, a bottle with old whiskey, and some water, is prepared. We get into a boat, and after an hour of hard rowing, we find ourselves in the middle of most extensive marshes, as far as the eye can reach. The boat is anchored, and we go on wading through mud and water, amid myriads of sand-flies and musquetoes, shooting here or there a bird, or squatting down on our hams for half an hour, to observe the ways of the beautiful beings we are in pursuit of. This is the way in which we spend the day. At the approach of evening, the cranes, herons, pelicans, curlews, and the trains of blackbirds are passing high over our heads, to their roosting places; then we also return to ours. If some species are to draw the next day, and the weather is warm, they are *outlined* that same evening, to save them from incipient putridity. I have ascertained satisfactorily that *feathers* lose their brilliancy almost as rapidly as flesh or skin itself, and am of opinion that a bird alive is 75 per cent more rich in colours than twenty-four hours after its death; we therefore skin those first which have been first killed, and the same evening. All this, added to our other avocations, brings us into the night pretty well fatigued. Such, my dear friend, is the life of an active naturalist; and such, in my opinion, it ought to be. It is nonsense ever to hope to see in the closet what is only to be perceived—as far as the laws, arrangements and beauties of ornithological nature is concerned—by

that devotion of time, opportunities, and action, to which I have consecrated my life, not without hope that science may benefit by my labours.

As to geology, my dear F., you know as well as myself, that I am not in the country for that. The instructions you gave me are very valuable, and I shall be vigilant. The aspect of the country will soon begin to change, and as I proceed, I will write to you about all we see and do. Whatever I state to you, you may rely upon; and if you think my letters, such as they are, are worthy of a place in your valuable Journal, there you are at liberty to place them, or any part of them. Do not be afraid of my safety; I take a reasonable care of my health and life. I know how to guard against real difficulties, and I have no time to attend to that worst of all kind of difficulties, imaginary ones. Circumstances never within my control, threw me upon my own resources, at a very early period of my life. I have grown up in the school of adversity, and am not an unprofitable scholar there, having learnt to be satisfied with providing for my family and myself by my own exertions. The life I lead is my vocation, full of smooth and rough paths, like every vocation that men variously try. My physical constitution has always been good, and the fine flow of spirits I have, has often greatly assisted me in some of the most trying passages of my life. I know that I am engaged in an arduous undertaking; but if I live to complete it, I will offer to my country a beautiful monument of the varied splendour of American nature, and of my devotion to American ornithology.

JOHN JAMES AUDUBON.

Ther. this day at 2, P. M. 78° Fahr.

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## ON THE GEOLOGICAL CHARACTER OF THE BEDS UPON WHICH THE CITY OF PHILADELPHIA STANDS.

*By* PETER A. BROWNE, ESQ.

DR. TROOST, in his geological survey of the environs of this city, has stated, that it is placed on an alluvion. I am of an entirely different opinion; and the distinction between alluvial and diluvial, is important, and has been well pointed out by Conybeare, and other geologists. These two deposites should never be confounded. The superficial soil upon which the city is built, consists of boulders, gravel, sand, loam, clay, and iron. All these

appear to have been derived from the primitive rocks. The boulders are granite, gneiss, mica, schist, hornblende, and quartz. The gravel stones are principally quartz. There are a few rolled pieces of chert, old red sandstone, &c.; but their numbers are so comparatively small, that their presence may be considered as accidental, and they can lay no claim to giving a general character to a deposite which is manifestly diluvial in its origin.

The boulders and gravel stones are partially rounded, indicating that they have not been brought from a great distance, and the nearest rocks in place are *primitive*. The felspar in the granite boulders is a dull opaque white, and in a state of partial decomposition. So it is in the neighbouring mica schist. Dr. H. Hayden, author of the geological essays, is of opinion, that the rolled pebbles of the diluvial districts of this country, lie generally from three to five miles, and sometimes more, from their original gangue, or locality. Guided by these considerations, we may venture to pronounce the superficial deposite upon which Philadelphia stands, to be a "primitive diluvial."

The next subject of inquiry is, by what means it was transported to where it is. The magnitude of the boulders, and the immense quantity of diluvial matter, preclude the idea that they have been brought by the Delaware and Schuylkill, even aided by any freshes, judging from present appearances, with which these rivers have ever been agitated. That a mighty current of water has, at no very distant period, passed over this continent, in a direction from N. and E. to S. and W., appears to be a fact well proved. The able manner in which Dr. Hayden has examined this subject, precludes any discussion of it here; I would, however, remark, that when Coats street and Fair Mount street were digging down to the regulation, I inspected the upper surface of the mica schist rock, as it was laid bare, and discovered furrows upon it, all tending from N. E. to S. and W., as if something hard or heavy had been dragged over it. This current was probably consequent upon a flood of a general character, and to which the diluvial matter owes its origin, being the comminuted materials of the rocks it had torn and abraded.

The materials of which this diluvial deposit is composed, are now found, according to observation and the best information, in the following order.

1st. A vegetable sod, or mould, which, where the ground is

level, and has not been disturbed by cultivation, is generally from four to six inches deep.

2d. When the situation is not very low, ten or twelve inches of a yellow, tough, silico-argillaceous earth, called "loam." When the situation is very low, this is of a gray colour.

3d. In some places, gray and yellow sand and clay; the sand sometimes coarse, and at others nearly impalpable; silicious pebbles, from the size of an egg to mere grains, are found here. In other places, under the yellow loam, the substance becomes hard and sandy, first of a slightly brown colour, and afterwards changing to gray sand. The depth of this stratum varies from three to six feet. Between this and the next stratum is sometimes found six or seven inches of black clay, in the lower side of which embedded pebbles are commonly found, some as large as paving stones.

4th. A fat, tenacious, and plastic clay, containing very little silicious sand, and very few pebbles. The depth of this varies; it is sometimes six or seven feet. Not more than one fourth of the site of Philadelphia has any of this stratum; where there is no clay, the place is supplied by sandy loam, mostly running into gray colour, as it approaches the next stratum. When the clay is regular, its depth is, on an average, three to four feet. This clay is what is called potter's clay. The three last strata mixed together form what is called brick clay. When the potter's clay is superabundant, it is sold to the potters, or reserved to mix with the sand and loam of other places, to make brick clay.

5th. A yellowish, and frequently dark brown mixture, partly chemical, and partly mechanical, of silicious, argillaceous, and ferruginous particles, passing into a sort of imperfect iron ore. This seldom exceeds in thickness two or three inches.

6th. Gravel, containing boulders as before stated. The gravel is coloured red with iron, and contains a small quantity of clay, which imparts to it an adhesive quality, and renders it a fine material for making gravel walks, or covering roads. Near the Schuylkill the boulders are large, and the gravel coarse; but the boulders gradually diminish in size and quantity, and the gravel gradually becomes finer as you approach the Delaware river. At Seventh street it is a fine sand. It is difficult to ascertain the depth of the gravel; water is generally found in it, at the depth of sixteen feet.

As to organic remains, while digging a cellar in Oak street, in the Northern Liberties, a large mass of madrepore was found in sand, eight feet below the surface. This happened so near to the Delaware, that I conjecture it came there with alluvial matter. I have never been able to detect any organic remains in the gravel; but in digging a well at the south end of the naval asylum, built by the United States, after passing the various strata above described, about on a level with the Schuylkill river, the workmen struck upon a bed of black alluvial, resembling river mud, in which was found wood, leaves, and bark; the latter so sound that it retained its natural colour, and upon inspection it was pronounced by good judges to have belonged to the hemlock. Before reaching this stratum of mud, the workmen found some pretty large stones, resembling paving stones.

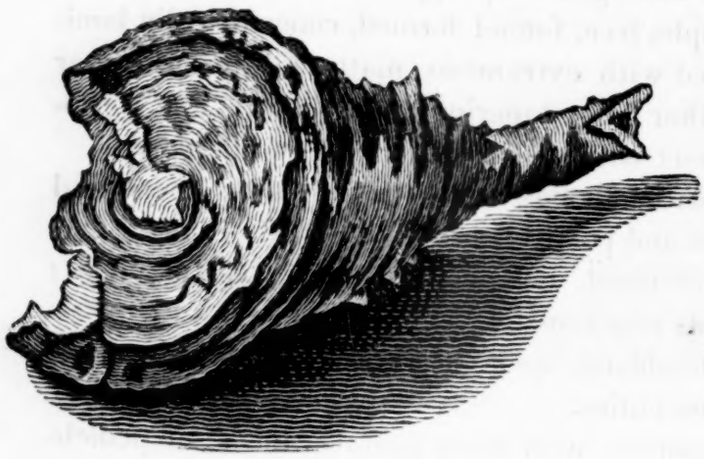
It would then seem, that before the deposit of this diluvial matter, there was a vast valley at this place, through which the Schuylkill river ran its peaceful course; that the bed of the river was strewed in the usual way with pebbles, and its banks shaded with hemlock trees.

About 38 years ago, a friend of mine dug a sink in a cellar, at the N. W. corner of Cherry and Seventh street, Del.: at the depth of about thirty feet from the bottom of the cellar, which was eight feet below the surface of the earth, the workmen found black marsh mud, in which were buried hickory nuts, acorns, leaves, and a log of wood; the latter in a high state of preservation. Before coming to the mud, the workmen passed through a stratum of plastic clay, a stratum of gravelly sand, coloured with iron, and a stratum of fine white sand. This furnishes an additional proof, that the present site of Philadelphia was, in ancient times, a hollow basin, or valley.

How gratifying thus to withdraw the curtain of time, and penetrate into the secrets of a remote antiquity. The apparently insignificant gravel stones which we indifferently tread under foot, when submitted to the scrutiny of the geologist, are found to be so many historical medals. They are indeed mute; but when compared with their parent rocks, and the beds which they now occupy, they speak eloquently of important changes this planet has experienced, and which tradition has confirmed.

In the clay of the site of Philadelphia are found some objects which are supposed by many to be fossil remains; others believe

*Plate* xi.



1

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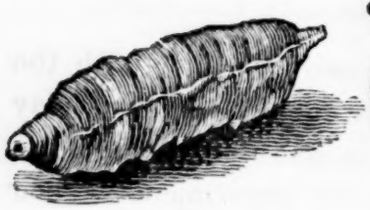
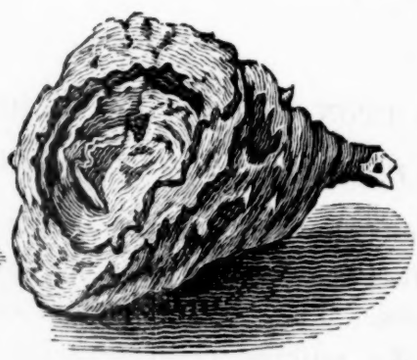
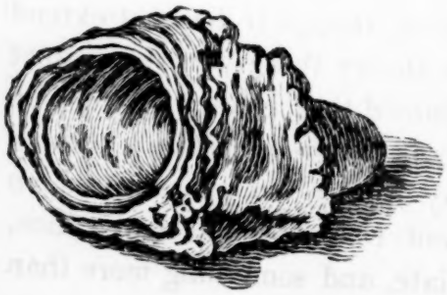


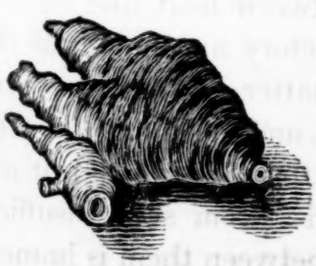
4



2



3



5

them to be mere nodules of iron and clay. The following are the forms in which they most generally appear.*

No. 1. Body simple, free, funnel formed, concentrically laminated; interior filled with extraneous matter; exterior rather smooth; pedicle rather long, tapering, bent slightly, and perforated; the whole beset with a few, remote, thorn-like points.

No. 2. Body tuberose, hollow; pedicle very short, bent, and perforated. Laminæ and points as in No. 1.

No. 3. Body cup-formed, hollow, and termination papillous; no pedicle, the points *very* remote.

No. 4. Body ovato-oblong, apex obtuse, smooth, pedicle short, no points, perforation entire.

No. 5. Body subglobose, with many protuberances; no pedicle or points, perforated.

No. 6. Body sub-cylindrical, transversely striated, perforated throughout, no points.

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## THOUGHTS UPON THE NATURE OF HEAT AND ELECTRICITY.

*To the Editor of the Monthly American Journal of Geology, &c.*

Sir,—The following remarks are drawn up rather with the hope of attracting attention to an obscure subject, than to display original views. They are the sum of considerable reading upon electricity, &c. without claiming scientific experiment as their basis. But hints often strike out sources of thought; and if these remarks can do that, they effect the whole design. I place them in your Journal because I wish it success, and because I am a subscriber.

Among many other bodies, the tourmaline is capable of displaying electrical phenomena. Heat, however, is necessary for this purpose, apparently offering an evidence of the intimate connection between heat and electricity, though it does not extend to a satisfactory argument, for the theory that they are distinct forms of matter. It may be presumed that electricity exists in the crystal, and that heat developes it. There is certainly nothing absurd in this view, though it may appear too exaggerated an idea to arise from such insufficient reasons. The connection, however, between them is immediate, and something more than

* See Plate.

an influence exerted by one over the other. For it is difficult to suppose that any natural phenomena could be caused, so entirely distinct from any of the known results produced by the agency of heat, where a similarity in nature and in function existed. There is certainly combustion, heat, light, &c., effected by electricity, in common with caloric; and this is a fair cause for supposing at least a direct reaction between them, a mutual interchange of duties, and almost that the one is a modification of the other. But no operation of mere caloric will discharge the pistol containing hydrogen, or decompose water, or display opposite effects at the same moment, by one portion of an instrument, or original form of matter becoming negatively or positively electrified. In developing the electricity of these substances, heat is necessary, though not a high temperature, and their electricity thus acquired, lasts while the body cools, though the polarities become changed. It would almost seem sufficient evidence that heat and the electric fluid were independent forms of matter, by this assuming of polarities. The cause of their formation it would require a deep insight into nature to discover. We can see no analogy between this result and any of the properties of caloric. An iron poker becomes magnetized by standing in a perpendicular position, and the magnetism is lost by heat. Now it would be a natural suggestion, that two fluids, thus reciprocally affected, were entirely opposite; that heat, destroying the magnetic property, could not of course exist with it. Yet it has been asserted that the green ray magnetized a needle exposed to it; and it is not doubted that heat and light co-exist; so that caloric and magnetism may be combined in the same kind of matter; and as caloric and electricity are more intimately related than light and magnetism, they may, for a strong reason, be found together. There is some connection, as yet unknown, and I believe unsuspected, between magnetism, perhaps caloric electricity, and the principle of gravitation; for the attraction of gravitation can only be considered as an effect of some undiscovered power. If any division could be made of these subjects, electricity might be considered as a property of the air, magnetism of the earth, and caloric an universally existing principle through the globe, and essential to the very being of matter. Heat may be presumed the result of a reaction among the particles of bodies; and one philosopher has gone so far as to suppose that a calorific

atmosphere exists around the particles of bodies, and that when excited, it produces expansion; if left at rest, the body contracts. Such an idea would follow immediately, from the knowledge of latent heat, whose discovery proves that caloric is a component part of all matter. If this be true, can matter remain the same after its removal? A body is made to yield caloric by being hammered, and in time becomes brittle by its abstraction; but it can exhibit the same phenomena if heated. Here the idea is at once formed, that the beating has driven the caloric out of it, and that this has been renewed by the application of fire. I see no objection to such a conception, though Davy calls it rude; yet it follows as a direct inference, from the assertion of the calorific atmosphere, which must partake of the usual habitudes of matter, and be liable to destruction. There is something so obscure in all relating to caloric, that it is almost useless to speak of it; for how can one comprehend that caloric is matter, and yet renewed faster than we can destroy it. Suppose a wheel had been put in motion at the moment of the creation, would it or not be capable of heating the axle on which it turns? A carriage wheel is probably as hot in five minutes after it commences motion, as at any time, and will continue so during a thousand miles, growing hotter and hotter, according to the speed, till it could be inflamed and consumed. Now if caloric be a component part of matter, why is it not wasted at once—and whence is it renewed? from the air, or the wood and iron? Speculations like the above may, by practical men, who deal—perhaps are only capable of dealing—with facts, be considered useless. They are so, when an immediate advantage is considered; they are not so when an enlarged view is taken, and remote ends anticipated. In this nation of common sense, there is a vast mass of humbug spouting from the ignorant and superficial, upon what they call practical utility. He who attempts any science, without a capacity for facts, can make nothing of it; but he who engages with nature, possessing that alone, is a mere day labourer, a compiler of crudities. There must be, in a contest with so subtle and protean a jade, intellect, powerful and comprehensive; invention, rapid and unceasing; habits of quick observation and zeal, with an entire devotion to the pursuit. When these are found united, America may rank among other nations in her contributions to science, but not till then. Lest, however, there should be a sneer

at my love of a fine and well woven speculation, I will plant a loaded battery at such a breach in knowledge, and just say, no man has ever been quick in any thing without a mind that grasped effects, and originated causes. Bacon speculated, Newton, Locke, Galileo, Davy, Dalton, and every man who will wave a flag over the ruins of the future.

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## OHIO SHELLS.

*Notices of Western Botany and Conchology.*—By C. W. Short, M. D. and H. Hulbert Eaton, A. M. (R. S.)

*Monograph of the Bivalve Shells of the River Ohio.*—Translated from the French of Professor Rafinesque, by C. A. Poulson, Esq.

The interesting paper under this head, which we find in the Transylvania Journal of Medicine and the Associate Sciences, published at Lexington, Kentucky, deserves to be transplanted from the medical journal we have named, that it may be more generally accessible to the lovers of natural history. The opportunities which naturalists enjoy, who are residents of the western country, of personally investigating—and *in place*—all those objects of so much interest to the now numerous body of inquirers, must always give them great advantages over their colaborators in natural science, who, bound to the Atlantic shores, by various urgencies, must study, and of course describe at the greatest disadvantage, objects that are often transmitted to them in a defective state, and that are accompanied by the ambiguous relations of the inexperienced persons who transmit them; for such we may generally suppose them to be, taking it for granted that resident naturalists choose always to announce their discoveries, rather than put their friends at a distance to the unnecessary trouble of doing it in a less effective manner. Remembering how exceedingly deficient we were once ourselves, it is by no means with the intention of speaking slightly of the imperfect attempts of the zealous uninitiated, to convey their views, that we make these remarks: the elementary course of geological instruction we have adopted for this Journal, is a proof of our solicitude to favour, as much as we know how, the incipient efforts of all lovers of nature. We have rather intended to mark our de-

ference and respect for the labours of those naturalists who are resident in the western country, and to express our regret that we have not more frequent opportunities of noticing them. They have a boundless field of inquiry; they are on the spot, and a host of anxious naturalists in Europe and America, ever ready to receive information from them. These are great inducements, and are sure to operate beneficially in the end; but we are of the present day, and are desirous of possessing all the information which the actual spirit of natural science solicitously calls for.

We take occasion to repeat here, that we shall always be ready to notice, in the most favourable manner, the discoveries and opinions of the naturalists of the western country; and the article now under consideration would not, perhaps, have escaped our attention so long, if it were not that a paper devoted to natural history, which is corked up, as it were, in a medical journal, although of the greatest respectability, was not likely to come under the notice—at the earliest day—of an editor who is not medical, and who has enough to do to keep up with the journals devoted to natural science.

Messrs. Short and Eaton made an excursion to the Ohio river, about eighty miles due north from Lexington. They directed their attention to the vegetable productions of the intermediate country, and to the shells of the Ohio, and the great Miami river. Of these objects they have given catalogues, restricted to those found during the excursion. The summer and fall had been unusually hot and dry; the catalogue, however, is represented to be a fair specimen of the latest autumnal flora of that part of the country, no plant being mentioned in it which was not found in flower, and the severe frosts which had commenced (16th Sept. 1830) before their return from the excursion, having finally arrested the florification of plants. This was, however, favourable to their other branch, conchology; the waters of the Ohio and Miami, being unusually low, and the shores more easily searched for some distance into the beds of the streams. The localities which were particularly resorted to for shells, were "those portions of the Ohio river, on the northern side, lying a mile or two above and below the mouth of Muddy creek, fifteen miles below Cincinnati, and the eastern borders of the great Miami, contiguous to the village of Cleves, in Hamilton county, Ohio." In the botanical catalogue, fifty plants are enumerated. Lycopus europœus.

L. virginicus. Collinsonia canadensis. Commelina communis. Schollera graminifolia. Ceresia fluitans. Isnardia palustris. Chenopodium botrys. C. anthelminticum. Gentiana quinqueflora. G. saponaria. Impatiens pallida. I. fulva. Lobelia syphilitica. L. inflata. L. Cardinalis. Onosmodium hispidium. Elodea petiolata. Mimulus ringens. M. Alatus. Mentha borealis. M. tenuis. Gerardia tenuifolia. Verbena hastata. Zapania nodiflora. Capraria multifida. Lindernia attenuata. Chelone glabra. Hyssopus nepetoides. Scrophularia marilandica. Erisimum palustre. Cleome dodecandra. Strophostyles angulosa. Rudbeckia triloba. R. fulgida. Coreopsis tricosperma. Bidens bipinnata. B. chrysanthemoides. Actinomeris squarrosa. Conyza camphorata. Eupatorium perfoliatum. E. Celestinum. Aster conyzoides. Prenanthes. Gnaphalium uliginosum. Helenium autumnale. Eclipta procumbens. Acnida cannibina. Ambrosia trifida. Asplenium angustifolium.

Of the shells collected in this excursion, we find thirty-six species of bivalves enumerated, and four species of univalves; but as we are desirous of making a few remarks on this branch of the paper, we shall now take up the neat monograph whose title appears at the head of our article, and which is entirely devoted to that subject.

We mentioned in our last number, "a continuation of a monograph of the bivalve shells of the river Ohio, and other rivers of the western states," which that veteran naturalist professor Rafinesque had just published. Since that period a translation of the monograph itself has been published by Mr. Poulson, and we have never seen any thing of the kind done with more ability, or with less ostentation. A well executed figure of the *unio verrucosa* is prefixed to it, which is sufficiently explanatory of the progressive motion of the animals which inhabit these bivalves, and about which there has been a great deal of misunderstanding. Conchologists, we believe, are agreed now, that the laws of physics may be as appropriate to the motion of shell fish as to that of dray horses; and that it is as well not to have the load too far from the draft power of the animal. We are glad of this, as it must have been the iron age to these little mollusca, whilst men of science gave them such prodigious long trace ropes.

Mr. Poulson dedicates his translation to William Hembel, esquire. It is not our place here to pronounce the eulogium of

this gentleman; but when so appropriate an occasion presents itself, of expressing our most sincere respect for the virtues and talents of a venerable and untiring friend to science, in all its various branches, we should be conscious of an omission if we were to say less than we do upon this occasion. From this neat and appropriate dedication, we extract the following passage, which will bring us at once in *medias res.*

"In publicly addressing to your notice a translation of professor Rafinesque's monograph of the bivalve shells of the river Ohio, and its tributaries, it seems proper to remark, that this paper was originally published at Brussels, in September, 1820, in the '*Annales Generales des Sciences Physiques.*' Extra copies were transmitted to the author in this country, who distributed them among individuals, and the libraries belonging to scientific institutions in this city and elsewhere. It is therefore a curious circumstance in the history of American conchology, that this singular evidence of the author's acumen, zeal, and industry should have thus existed for more than eleven years, *while but four of the numerous species discovered and described by him*, are known by his names, either in the works of American authors, or in our collections."

Now, four species out of sixty then made known, is $6\frac{3}{4}$ per centum; and although $6\frac{3}{4}$ per centum is very good interest in money matters, yet we have but an indifferent opinion of dividends of this character, in natural history, particularly when by adroit arrangements of others, this $6\frac{3}{4}$ per centum is only once paid, and must figure away ever after as all the capital the original holder is entitled to. This is pretty much the predicament in which professor Rafinesque has been placed by the management of others, according to the account of himself and his friends. He paid into the hands of the commissioners of conchology, sixty species, dead and alive; and lo! and behold! when he comes to ask for his annual interest out of the reputation fund, he is told that no more than four species appear entered in the books to his credit. If this had been a money transaction, there would have been a great noise about it; but as it is only about shells without any oysters in them, people disregard it, nay, even laugh at it; which is very wrong. Now we love fair play, and what is better, we love shells better than oysters, and therefore we feel disposed to get up a little noise about this matter, but in a good natured way, and with a view to justice and future harmony.

That our readers may have professor Rafinesque's statement from himself, we extract from his "Continuation of a Mono-

graph," published in Philadelphia, October, 1831, the following passages.

"Hardly a dozen species of North American fluviatile bivalve shells had been mentioned by Bosc, Lamark, Say, and Lesueur, before 1820, when I described, in a special and ample monograph, 75 species of them, with 40 varieties, mostly discovered by myself, in my travels of 1818 and 1819, and figured 28 of them."

"Since 1820, several American conchologists have attempted to notice, describe, or figure these shells. Barnes in 1823. Lea, Say, and Eaton, later still. They had a fine field before them, in elucidating them by good figures, and describing the new kinds; but led astray by various motives, they have neglected to verify, or properly notice my previous labours, *although they were known to them.* Mr. —— is, above all, inexcusable. I had respectfully noticed, in 1820, his previous labours; but he has never mentioned mine, and knows so little of the animals of these shells, as to have mistaken their mouth for their tail, and their anterior for the posterior part of the shells!

"*If he had seen these animals alive, feeding, moving, and watched their habits, as I have done repeatedly,* he would not have fallen into such a blunder."

"This continuation will be a supplement to Mr. Poulson's translation of my monograph of 1820. I mean to give in it my shells, under my own names, imposed as soon as found in 1821 and 1822 chiefly; the undoubted right of a previous discoverer and explorer. If some of them are already well named and described, let their names be compared, and the oldest or best prevail, as those of my old monograph ought in all cases."

The whole question as to the quantum of injustice done to professor Rafinesque, lies in the compass of a nutshell; either his discoveries in 1820 preceded those of the conchologists he has alluded to, or they did not; and they have been describing and naming shells he had previously described and named, or they have not. We must presume his monograph was known to them, as it was notorious, both in Europe and this country; and a true son of nature never pretends to occupy ground with permanent views, of which the pre-emption rights have not been examined into, and extinguished. Those who act otherwise, are conchological squatters, and are subject to a declaration of ejectment being filed against them. Into this matter we shall not further enter, as we have reason to believe that one of our correspondents, better fitted to do justice to the subject, is likely to give us his views on it ere long.

Professor Rafinesque has no reason to reproach Messrs. Short and Eaton with injustice to him, as they have given him full credit; there is an air of candour and intelligence about their paper, which recommends it highly. They appear to be familiar with the labours of all the American conchologists, and their own

*practical* remarks upon the shells whose structure they have studied in their native beds, have a somewhat satirical cast. We hope these practical remarks will be continued; they will prove an admirable corrective to that fault of extensive generalization from slender premises, which inexperienced and ardent persons are apt to fall into. Our readers, perhaps, understand that the characters which some writers on these shells have resorted to, upon which to found their species, are derived from their shape, and the external marks which they bear. Thus the *unio plicatus* is so called from having inequalities on the shell, which are called *folds;* the *unio sulcatus*, from its having indents or *furrows;* the *unio cornutus*, from protuberances, which are called *horns;* the *unio verrucosus*, from protuberances, thought to resemble *warts;* the *unio tuberculatus*, from protuberances resembling *tubercles;* the *unio securis*, from a resemblance to the edge of an *axe:* then there is the *unio circulus*, *unio orbiculatus*, *unio subrotundus*, *unio triangularis*, from their approximation to a round or angular shape. It is usual to find the unios of the Ohio, very much decorticated at the beaks; one, from being particularly so, has been called *unio cariosus*, or the *carious unio.*

Messrs. Short and Eaton lay the axe at the root of all these hasty attempts at classification, by showing that the *carious unio* of the Ohio, is also found in the Miami, where *it is not in the least degree carious;* and that some of these shells are nearly *circular*, some *quadrangular*, some *ovate*, and some almost perfectly *elliptical*, so that here we have a unio which is without its own specific characters, whilst it has got those of almost every other shell; for it has got its place in the books as *unio cariosus*, whilst it is never carious in the Miami, and has the distinctive cognominal characters of the *unio ellipsis*, the *unio circulus*, the *unio orbiculatus*, the *unio subrotundus*, the *unio ovatus*, &c. &c. &c.

Thus we see how insecure are the grounds upon which men build, who trust to the external forms of shells, as the sole means of giving to an important family of molluscous animals their proper place in the scale of animal existences. These animals could not pursue the same object with less effect, if it were given to them to attempt to assign a natural place to our biped race, by describing all the dwelling houses between the Delaware and Schuylkill, where some are amorphous from want of taste, some mean from the poverty of the owner, others ornamented and

spacious, for the contrary reason; and where all the varied forms have grown out of the indispensable wants, the abilities and taste of the inhabitants, whether these have been acquired in America, Europe, or in China. Decorticated beaks would not be wanting; yet Chesnut and Arch streets—those Miami's of houses—would furnish abundant exceptions; and then as to cornutus, horns, as long as chimneys were standing, would not be wanting, long or short. In regard to the unio cornutus, it fares no better in the hands of Messrs. Short and Eaton, than *unio cariosus.* They remark on this shell, to which they have assigned professor Rafinesque's original name of *unio torulosus:* "all possible varieties of this heteramorphous shell were found in the Ohio: the *unio foliatus* of Hildreth, which Mr. Lea thinks nothing more than a variety of the *unio cornutus* of Barnes, was found, and among our numerous specimens of this variety, *not one had hardly the rudiment of a horn.*"

Here we have horned shells without horns, as we before had carious shells perfectly sound. What would be said of the want of sense of cattle breeders, if they were to talk of long horned cattle with no horns, and Durham short horns with long horns. These practical men know that the Durham short horn, and the Bakewell breed of sheep, both of which, externally, differ from all other animals of the same races, are artificial varieties produced by particular treatment; but that if the circumstances to which the varieties were owing, no longer influenced them, the varieties would disappear. We have seen that the same shell can differ greatly in its shape; that it is sound in one river, and carious in another. What the particular causes of such cariousness are, we know not at present; but we do know that mollusca repair their own shells when injured, and may infer that the degree of intelligence requisite for that act, may govern the young mollusca in modifying the primary form of its shell, according to the exigences of the circumstances which surround it; and that when it is much varied, it is but evidence of what the animal is capable of doing for conservative purposes.

When conchologists study the animals more, and the shells less, or rather when they consider the animals themselves as the proper objects of study, every accession to our knowledge of this branch, can be carried to the general account of natural history, to the honour of the discoverer. Writers who contend for priority

in naming shells, even when they succeed in establishing their claims, will acquire no lasting reputation, unless they show they have studied the animals too. We mean no offence in our remarks to any one. Several of the most conspicuous conchologists of this country, Say, Barnes, Lea, and others, have made important remarks on the structure and habits of the mollusca; but at present the general pursuit appears to be after the shadow, rather than the substance; and we regret it both for the sake of zoology and for the sake of our conchologists.

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## METEOROLOGICAL OBSERVATIONS,

*Made at Wilmington, Delaware, by Henry Gibbons, M.D.*

SUMMARY FOR DECEMBER, 1831.

| | *Therm.* | *Barom.* |
|---|---|---|
| Average at sun-rise, | 19°.39 | *in.*29.83 |
| Average at mid-day, | 28°.94 | 29.76 |
| Average at 11 o'clock, P. M. | 20°.77 | 29.77 |
| Monthly average, | 24°.16 | 29.795 |
| Maximum, 21st, | 41°. | 30.20 |
| Minimum, 16th, | 0°. | 29.23 |
| Range, | 41°. | 97 |
| Warmest day, 24th, | 35½°. | |
| Coldest day, 16th, | 6½°. | |

| | |
|---|---|
| Proportion of clear weather, *days* | 18 |
| Proportion of cloudy, | 13 |
| Whole days clear, | 12 |
| Days on which rain fell, | 1 |
| Days on which snow fell, | 8 |
| Quantity of rain, *in.* | 2 |
| Depth of snow, | 6.75 |
| Of water,* | 2.10 |
| Northerly winds prevailed, *days* | 16 |
| Easterly, | 6 |
| Southerly, (S. to W.) | 9 |

Auroras, none. The month rather dry: snows frequent, but not deep; rain fell only once, and then in very small quantity. Temperature uniformly cold; much below the usual standard for this month. The thermometer was above the freezing point at sun-rise on one day only, and at noon on nine days. (See the review of the year.) Winds occasionally high, and mostly unsteady, flowing from no one quarter of the compass so long as two successive days, except on two occasions. No electrified clouds. Four easterly storms, three of them with snow, the other dry; none of them severe.

### *General Review of the Weather for the year* 1831.

THE last month of 1830 was mild, and the weather continued open till the 9th of January, 1831, when winter set in with a storm of sleet and snow, from N. E. This was followed by the memorable snow-storm which commenced on the evening of the 14th, and terminated at noon on the 16th, after a duration of 42 hours, exceeding in violence any thing that had before oc-

* Nine inches of *light* snow are equivalent to one inch of water; the proportion, however, varies with the character of the snow.

curred within the memory of the oldest inhabitants. The snow was excessively drifted; its average depth being about two feet. The storm extended beyond the Alleghanies, but was there unattended with wind; so that the snow fell calmly to the depth of near three feet. After much severe cold, and several other storms of snow and rain, the winter quietly broke up towards the latter end of February. The navigation of the Christiana creek, and of the Delaware river, near Philadelphia, was closed, or rendered impracticable by ice, from the 12th of January, to the 3d of March—a period of seven weeks.

The spring of 1831 was rather forward, and generally mild. In the second week of April, however, several severe frosts occurred, which injured much of the earlier fruit, then in bloom. A good deal of rain fell in March and April; but in May, there was only one rain of consequence, and that one not very heavy. The month of May was, of course, very dry, so as to injure materially some of the crops. The few last days were unseasonably hot.

After the middle of June, the summer of 1831 was remarkable for damp weather, and excessive rains, which extended over a great part of the United States. The grass crops had been injured by drought; and now the crops of grain were very much damaged by wet. So moist was the atmosphere, that the "dry-goods," of store-keepers, became mouldy on the shelves, in many instances. Two feet of rain fell in July and August. There was no hot weather, though it was often oppressive, on account of the moisture which loaded the atmosphere. In the third week of August, a dense haze obscured the sky, imparting a peculiar colour to the sun and moon—a yellowish green tinge. From the beginning of July to the termination of the year, the air was scarcely clear of a haziness for an hour at a time. It appeared to have a close connexion with the tendency to produce clouds, which was observed at the same time to exist in the ærial laboratory of nature. Doubtless its cause must be referred to the precipitation of vapour. The ruddy haze of Indian summer is a phenomenon very analagous; but when we consider the vast quantity of vegetable exhalations which must result, at this season, from the decomposition of plants, and the desiccation of the foliage of the immense American forests, we cannot but grant to the effluvia of decaying vegetation, some agency in the formation of the haze of our autumnal sky.

The temperature of the autumn months was seasonable. In September and October, much rain fell; but not so much in November. On the whole, the fall of 1831 may be considered very pleasant. Not a single severe frost occurred till after the middle of November; but winter then set in, without any preliminary steps, at least one month earlier than usual.

The year 1831 exhibits several calamitous events in the history of the weather. The unrivalled snow-storm of January, rendered the roads, for a time, impassable. The drought of May, (which, however, was not very extensively felt,) excited the reasonable apprehension of the husbandman; whilst the subsequent torrents of rain were still more injurious. Finally, the sudden onset of winter, for which many were unprepared, put a period to the navigation of the rivers, and gave rise to much suffering among the crews of vessels on the coast.

The month of December, 1831, will hold a conspicuous place in the annals of meteorology, and will require more particular notice, in connexion with the winter of which it forms a part. I will take the liberty of remarking in this place, that the *meteorological year* ought to consist of four successive seasons, commencing with December, or with March. According to the Julian calendar, the year which begins with January, comprises only three entire seasons, and portions of two winters.

For the present, it will suffice to say, that the thermometer has never before sunk to zero, in this month, since the commencement of the 19th century—that the December of 1818 was the only one which equalled it in its average degree of cold since 1807, and perhaps for a longer period—that during the same term of 24 years, there was not so much snow in any one December, nor so small a quantity of rain. Before the termination of the month, the 'old fashioned" winter was a topic of general remark; and it was discovered by many *savans*, that the "goose's bone" predicted a hard winter!

In the following table, the mean given for each month is the average of two series of observations; the one taken at sun-rise, and the other at noon, or a little after. The yearly temperature of 51°, is at least one degree below the average standard of this latitude, which may be ascribed almost entirely to the cold of the last month of the year. In one column is given the number of days in each month, on which high winds occurred, which

will be found to bear some relation to the range of the barometer. In the column of easterly storms, are included those which were unaccompanied with rain, amounting to about one third of the whole number. The column of electrified clouds indicates the number of days on which electrical phenomena occurred, to any considerable extent. In some remarks, published in the 5th No. of this Journal, the manner of obtaining the results in most of the remaining columns, is explained. For the sake of comparison, the summary for the year 1830 has been added.

*General Summary for each Month of* **1831**, *and for the whole Year; and also for* **1830**

| Thermometer. | | | | | | Barometer. | | | | Days. | | | | | | | | | | Inches. | | | Days. | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Months. | Mean. | Maximum. | Minimum. | Range. | Warmest day. | Coldest day. | Mean. | Maximum. | Minimum. | Range. | Proportion of clear weather | Proportion of cloudy do. | Whole days clear | No. of days rain. | No. of days snow | Northerly winds | Easterly winds. | Southerly winds. | High winds. | Easterly storms | Auroras. | Electrified clouds | Quantity of rain | Do. of snow. | Do. of water. | Range. |
| Jan'y. | 25.05 | 65 | 4 | 61 | 51 | 10.5 | 29.66 | 30.17 | 28.99 | 1.18 | 15 | 16 | 13 | 3 | 11 | 16 | 9 | 6 | 4 | 5 | 2 | 1 | 2.50 | 33.5 | 7.35 | |
| Feb. | 26.94 | 45 | 7 | 38 | 39.5 | 13 | 29.82 | 30.63 | 29.14 | 1.49 | 22 | 6 | 20 | 4 | 1 | 17 | 5 | 6 | 6 | 6 | 2 | 1 | 3.30 | 3. | 3.65 | |
| March | 43.91 | 67 | 22 | 45 | 63 | 31.5 | 29.73 | 30.31 | 29.27 | 1.04 | 20 | 11 | 17 | 8 | 1 | 7 | 4 | 20 | 1 | 2 | 1 | 1 | 2.65 | 2. | 2.65 | |
| April, | 51.56 | 72 | 28 | 44 | 62.5 | 35.5 | 29.64 | 30.05 | 29.13 | .92 | 14 | 16 | 11 | 8 | 0 | 10 | 12 | 8 | 1 | 4 | 1 | 1 | 5.90 | 0 | 5.90 | |
| May, | 62.25 | 87 | 38 | 49 | 77 | 48 | 29.74 | 30.12 | 29.25 | .87 | 22 | 9 | 21 | 1 | 0 | 7 | 6 | 18 | 0 | 2 | 1 | 0 | 1.00 | 0 | 1.00 | |
| June, | 71.93 | 88 | 47 | 41 | 79 | 57 | 29.86 | 30.10 | 29.67 | .43 | 17 | 13 | 14 | 7 | 0 | 6 | 10 | 14 | 0 | 6 | 1 | 5 | 1.98 | 0 | 1.98 | |
| July, | 73.74 | 87 | 53 | 34 | 80.5 | 61 | 29.87 | 30.17 | 29.53 | .64 | 20 | 11 | 16 | 13 | 0 | 9 | 6 | 16 | 1 | 0 | 3 | 9 | 12.07 | 0 | 12.07 | |
| Aug. | 72.95 | 85.5 | 52 | 33.5 | 80 | 60.5 | 29.91 | 30.15 | 29.68 | .47 | 18 | 13 | 13 | 8 | 0 | 8 | 10 | 13 | 1 | 1 | 6 | 4 | 11.90 | 0 | 11.90 | |
| Sept. | 64.46 | 83 | 44 | 39 | 77 | 55 | 29.84 | 30.04 | 29.44 | .60 | 16 | 14 | 12 | 10 | 0 | 11 | 7 | 12 | 2 | 4 | 0 | 6 | 7.25 | 0 | 7.25 | |
| Oct. | 55.65 | 75 | 36 | 39 | 67.5 | 44 | 29.85 | 30.18 | 29.39 | .78 | 23 | 8 | 19 | 8 | 0 | 12 | 6 | 13 | 4 | 1 | 1 | 2 | 8.00 | 0 | 8.00 | |
| Nov. | 40.26 | 61 | 20 | 41 | 54 | 26 | 29.69 | 30.03 | 28.73 | 1.30 | 21 | 9 | 16 | 4 | 4 | 21 | 6 | 3 | 7 | 4 | 0 | 1 | 2.52 | 4 | 3.02 | |
| Dec. | 24.16 | 41 | 0 | 41 | 35.5 | 6.5 | 29.79 | 30.30 | 29.23 | .97 | 18 | 13 | 12 | 1 | 8 | 16 | 6 | 9 | 3 | 4 | 0 | 0 | .02 | 16.75 | 2.10 | |
| 1831, | 51.07 | 88 | 0 | 88 | 80.5 | 6.5 | 29.78 | 30.63 | 28.73 | 1.90 | 226 | 139 | 184 | 75 | 25 | 140 | 87 | 138 | | 39 | 11 | | 59.17 | 59.25 | 66.87 | |
| 1830, | 52.23 | 92.5 | 4 | 87.5 | 84 | 11 | 29.72 | 30.52 | 29.08 | 1.44 | 205 | 160 | 148 | 87 | 9 | 143 | 84 | 138 | | 34 | 14 | | 49.90 | 16. | 51.90 | |

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## SCIENTIFIC AND GENERAL MEMORANDA.

*Limestone Caves in Schoharie, State of New York.*—Some of those extensive and irregular cavities, which are so conspicuous in the carboniferous limestone of the United States, and of a few of which—situated in the Helderberg hills, near Albany—descriptions have been given, have been lately explored in the continuation of the same chain, near the village of Schoharie. Mr. John Gebhard, with some enterprising mineralogical friends, visited, in September last, one of those interesting natural phenomena. Mr. Hubbard was let down one, a perpendicular fissure, about ten feet long, and six feet broad, a distance of about seventy-five feet, where the descent declined to the south, and where he awaited the arrival of Mr. Branch. They followed this new direction at an angle of about sixty degrees, for about fifty-five feet, when the descent became again perpendicular, for fifteen feet. Overcoming this, and resuming the preceding direction for

about thirty feet, they reached the bottom, where they found a stream of limpid water, running south. Whilst pursuing the course of this stream, they visited a spacious apartment, about twenty feet broad, and more than a hundred feet high. In this room they found the skeleton of an animal, believed to be a fox, which, perhaps, having fallen through in some part, had died for hunger. The stream led to a body of water, which, having no means of exploring, they returned upon their steps, and rejoined their friends.

In October, Mr. Gebhard, Mr. Bonny, and Dr. Foster, having constructed a boat, contrived to get it afloat upon this subterranean lake, and with other friends, having manned the boat, navigated the lake for three hundred feet, through various passages, in one of which the water was thirty feet deep, and transparent to the bottom. At a shelving ascent on the right shore of the lake, the water appeared to be lost by an invisible drainage. They were here rewarded by the discovery of a very magnificent apartment, the description of which we shall borrow from an account of the adventure, drawn up, we presume, by one of the party, and which a friend has forwarded to us in a number of the Troy Centinel.

"Advancing up the shelving ascent, about twenty feet, they entered an aperture in the rock, directly in front, of about the size of an ordinary entrance to a house, where a scene, grand beyond description, burst upon the view. They advanced through this opening into a vast amphitheatre, hitherto untrod by mortal foot, which, from its perfectly regular and circular form, obtained at once the name of the rotunda. Upon giving this apartment a particular examination, after the first feelings of surprise had subsided, they found it about one hundred feet in diameter, and apparently more than a hundred feet in height, regular in its form, the floor descending on all sides, gradually, to the centre, and forming a spacious gallery around its whole circumference, and enclosed above by a horizontal roof. The vast size of this apartment, the magnificence of the gigantic walls, and fretted roof, both entirely encrusted with transparent crystals, which sent back the blaze of the torches in a thousand different dyes, at once satisfied the beholders, that they had penetrated into the very temple, in these hitherto unexplored realms."

After freighting their little bark with a rich cargo of mineralogical curiosities, they returned to the upper world, delighted with the success of their voyage.

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*Zoological Weather Glass.*—"At Schwitzingen, in the post-house, we witnessed, for the first time, what we have since seen

frequently—an amusing application of zoological knowledge, for the purpose of prognosticating the weather. Two frogs, of the species rana arborea, are kept in a glass jar, about 18 inches in height, and six inches in diameter, with the depth of three or four inches of water at the bottom, and a small ladder reaching to the top of the jar. On the approach of dry weather, the frogs mount the ladder; but when wet weather is expected, they descend into the water. These animals are of a bright green, and in their wild state, climb the trees in search of insects, and make a peculiar singing noise before rain. In the jar, they get no other food than now and then a fly, one of which, we were assured, would serve a frog for a week, though it will eat from six to twelve in a day if it can get them. In catching the flies put alive into the jars, the frogs display great adroitness."—*Mr. Loudon.*

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*Attachments between Animals.*—Mrs. Bowditch relates, in the Mag. of Nat. History, that when she was in Paris, there were two remarkable fine ostriches, male and female, at the Jardin du Roi, and that one of them died in great agony, after swallowing a broken piece of glass. From the moment his companion was taken from him, the male bird had no rest; he appeared to be incessantly searching for something, and daily wasted away. He was moved from the spot, in the hope he would forget his grief; he was even allowed more liberty, but nought availed; and he literally pined himself to death. Upon another occasion, she states, that a curious expedient was resorted to, to prevent a similar catastrophe. A gentleman had, for some years, possessed two cranes, (ardea pavonina;) one of them died, and the survivor became disconsolate. He was apparently following his companion, when his owner introduced a large looking glass into the aviary. The bird no sooner beheld his reflected image, than he fancied she for whom he mourned had been restored to him; he placed himself close to the mirror, plumed his feathers, and showed every sign of happiness. The scheme answered completely; the crane recovered his health and spirits, passed almost all his time before the looking glass, and lived many years after. These are curious instances of the strength of the social principle in birds.

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*Presentiment in a Goose.*—The following anecdote is from the Mag. of Nat. History. "An old goose, that had been sitting upon

her eggs for two weeks, in a farmer's kitchen, was perceived, on a sudden, to be taken violently ill. She soon after left the nest, and repaired to an out house where there was a young goose of the first year; this she brought with her into the kitchen. The young one immediately scrambled into the old one's nest, sat, hatched, and afterwards brought up the brood. The old goose, as soon as the young one had taken her place, sat down by the side of the nest and shortly after died." The young goose had never been in the habit of entering the kitchen before, and the person who relates the transaction, received the account the same day it occurred, from his sister, who witnessed it.

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*Delta of Oroonoko and Maragnon.*—M. Gutmuths states the increase of the mud, which is encroaching on the sea, on the Guiana coast, is aided by the tangled roots of the Rhizophora Mangle, which extend to the very edge of the waves, and even under the water. The sea is muddy along the shore, 200 geographical miles in length, by 10 in breadth, whilst at the same time the rivers are limpid. The Maragnon no doubt contributes a great portion of the alluvial matter; it has a course of 1350 miles, a great depth, and a breadth of 50 miles at its mouth; and during the freshes occasioned by the rainy season, and the melting of the snow upon the Andes, it exhibits the inundations of an immense sea of water, charged with earthy detritus and vegetable remains. The current is then so strong, that it is perceptible at sixty miles from the coast; and this, being opposed by the usual current of the Atlantic, from east to west, gives origin to vast banks of sand towards the shores of Brazil, on the north-west of Guiana. One of the circumstances which contribute so powerfully to this effect, is the *pororoca*, or high flux, which occurs at the mouth of the Maragnon, three days before every new and every full moon. It arrives in two hours at the beach, in mountainous waves, of 12 to 15 feet high. The sea is then driven more violently towards the north-west, and, along the coast of Guiana, forms very strong currents towards Esequibo and the gulf of Paria, becoming still stronger as they approach the Amazon river. The pororoca destroys the shores entirely, between Fort Macapa and Cape North; and, if there were no rocks, the beach would be still more dismantled, and the mouth of the Maragnon turned altogether to the north.—*Mag. Nat. Hist.*